

## **BURROWING OWL (*Athene cunicularia*)**

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### **Criteria Scores**

Population Trend	Range Trend	Population Size	Range Size	Endemism	Population Concentration	Threats
15	5	5	0	0	0	20

### **Special Concern Priority**

California: Currently ranked as a Bird Species of Special Concern, Priority 1.

*Federal*: Undergoing status review.

*Other*: Natural Heritage Rank G4/S2.

### **Breeding Bird Survey Statistics for California**

There were significant increases in relative abundance in California for the 1966-2001 survey period (Trend = 5.5,  $P < 0.01$ ,  $n = 32$ ). The 1980-2001 interval mirrored this trend (Trend = 5.0,  $P < 0.05$ ,  $n = 24$ ). Data credibility is considered good, with adequate sample size and moderate precision, and moderate abundance along the routes (Sauer et al. 2002). However, the Christmas Bird Count data indicate a declining trend in overwintering owls over the period 1959-1988 (Trend = - 1.2,  $P < 0.05$ ,  $n = 97$  (Sauer et al. 1996)).

### **General Range and Abundance**

This species is broadly distributed in western North America and it also occurs in Central and South America, on Hispaniola, Cuba, the northern Lesser Antilles, and the Bahamas (Haug et al. 1993). In North America, there are two subspecies, *A. c. hypugaea*, which is distributed throughout the western half of the continent, and *A. c. floridana*, which is restricted to Florida and the Bahamas (Haug et al. 1993). Owls in Florida generally appear to be year-round residents

(Millsap 1996). In the remainder of the range, the most northern and eastern breeders appear to migrate south in a leap-frog fashion, with Canadian owls thought to overwinter in Central America (James 1992); however, little data exists to properly evaluate migration. North Dakota breeders were recovered in Texas and Oklahoma during the winter (Brenckle 1936). Most owls winter in California, Arizona, New Mexico, Texas, and Louisiana, with California considered the most important wintering ground (James and Ethier 1989). Owls breeding in Oklahoma (Butts 1976) and central New Mexico (Best 1969, Martin 1973) appear to disperse or migrate. In southern New Mexico, males were winter residents but females left the breeding grounds (Botelho 1996).

### **Seasonal Status in California**

Burrowing owls appear to be winter residents throughout much of the state as demonstrated through the year-round residency of color-banded owls, although they may be migratory in the northernmost parts of California (Thomsen 1971, Coulombe 1971). However, research on color-banded owls in the San Francisco Bay region demonstrates that at least a large part of the population there is resident (L. Trulio et al, unpublished data). Breeding range extends throughout the Central Valley, the Imperial Valley, in the desert regions of the northeastern and southeastern part of the state, and along the central and southern coasts (DeSante et al. 1997). It appears that winter migrants from other parts of North America may augment resident populations, although specific information is lacking.

### **Historical Range and Abundance in California**

Early accounts list the burrowing owl as very common (Canfield 1869), and in 1944, large numbers of owls still occurred in favorable localities although they were apparently declining in areas of human settlement (Grinnell and Miller 1944). The historic range covered

much of the state, wherever suitable habitat occurred. Coastal counties north of Marin and the mountains (Sierra Nevada and Coast Range) were recorded as not supporting burrowing owls (Grinnell and Miller 1944).

### **Recent Range and Abundance in California**

The recent changes in burrowing owl distribution are leading to its extirpation in many counties but large populations persist in the Imperial and Central Valleys. A large survey effort in Central California indicated that the burrowing owl was extirpated from San Francisco, Ventura, Sonoma, Marin, Napa, and Santa Cruz counties over the period of 1981-1991, although owls were uncommon in these counties prior to extirpation (DeSante et al. in press). Declines were greatest along the coast, while the population within the Central Valley appeared to be declining at 8.6% from 1981-1991; the total Central California breeding population was estimated at 873 pairs (DeSante et al. 1997). This represents about 24% of the state's breeding pairs (DeSante et al. unpublished data, Klute et al. in preparation).

In contrast, populations in the Imperial Valley appear to have increased with the intensification of agricultural activity, from originally sparse numbers (Garrett and Dunn 1981, DeSante et al. in press). Burrowing owls in this region currently appear to attain some of the highest densities recorded for the species. This population may comprise over 70% of the known owls in the state (DeSante et al. in press). However, the species appears to be extirpated from the Coachella Valley to the north of the Imperial Valley (DeSante et al. in press). Overall, the pattern appears to be one of declining populations in the areas with the greatest urban growth, with large remnant populations existing in areas of intensive agriculture (e.g., Gervais et al. 2003, Rosenberg and Haley 2003), or designated open space. Owls also persist in grasslands

such as the Carrizo Plain Natural Area (Ronan 2002) but surveying these regions is difficult and the true magnitude of these remnant populations is unknown.

Demographic work on four California populations suggest variable population trends over five years, with each population experiencing good and bad years for survival and reproduction (D. K. Rosenberg et al., unpublished data; Gervais 2002, Ronan 2002, Rosenberg and Haley 2003). There appears to be a metapopulation dynamic linking at least populations among the Carrizo Plain, the San Jose area, and the Central Valley around Lemoore; owls banded at Naval Air Station Lemoore have been recovered as breeders at the Carrizo Plain and the San Jose area. In addition, the number of breeding pairs in the Central Valley (Naval Air Station Lemoore) and the Imperial Valley study sites remained nearly constant between 1997 and 2000, despite dramatic fluctuations in productivity and survival (Gervais 2002, Rosenberg and Haley 2003).

Throughout North America, burrowing owl populations appear to be declining in many regions. The species is listed as Endangered in Canada (Wellicome 1997). In the United States, California, Idaho, Kansas, Montana, Nebraska, North Dakota, Oklahoma, Oregon, South Dakota, Utah, and Washington all categorize the burrowing owl as a Species of Special Concern or equivalent (Sheffield 1997). However, population trends as estimated by the Breeding Bird Survey are equivocal, with the United States overall and the Central Region showing a statistically insignificant declining trend, whereas the Western Region and California showed statistically significant increasing trends (Sauer et al. 1996). Across its range, however, the species is likely to suffer from destruction of habitat due to rodent extermination campaigns and conversion of land into more urban uses. Loss of habitat is indirect evidence supporting the apparent population declines in many parts of the burrowing owl's range.

## **Ecological Requirements**

The burrowing owl is primarily a grassland species, but it is capable of persisting and even thriving in landscapes highly altered by human activity. Owls living in the intensive agricultural matrix of the Imperial Valley nest along water conveyance structures surrounded by crops, yet occur in densities that are among the highest ever recorded for the species (DeSante et al. in press, Rosenberg and Haley 2003). Owls in the Central Valley were found nesting along roadsides and canals, and even under the runways and associated structures of Naval Air Station Lemoore (Gervais 2002) and were found to forage in the surrounding agricultural fields (Gervais et al. 2003). In Santa Clara county, owl populations persist in sites as varied and developed as Moffett Federal Airfield and a busy urban park (Trulio 1997). The overriding characteristics appear to be the presence of burrows for roosting and nesting, and vegetation structure that is relatively short with only sparse shrubs or taller vegetation.

Burrowing owls depend on burrows for nesting; these are most commonly dug by prairie dogs and ground squirrels (Haug et al. 1993), although badger holes (Green and Anthony 1989), coyote dens (J. A. Gervais, personal observation), and other burrows may be used. Burrowing owls are capable of excavating their own burrows in the soft soils of the Imperial Valley's water conveyance structures (J. A. Gervais, personal observation). Man-made structures such as culverts, piles of concrete rubble, and pipes may also be successfully used (J. A. Gervais, unpublished data).

Their prey include a broad array of taxa, from arthropods (centipedes, spiders), insects (particularly beetles, crickets, and grasshoppers), small rodents, birds, amphibians, reptiles, and carrion (Thompson and Anderson 1988, Green et al. 1993, Plumpton and Lutz 1993, Gervais et al. 2000, York et al. 2002). Although insects dominate the diet numerically, vertebrates may

account for the vast majority of the biomass (Green et al. 1993). In California, there is evidence that rodent populations, particularly those of California voles (*Microtus californicus*), may greatly influence survival and reproductive success; both functional and numerical responses were noted to an outbreak of *M. californicus* in 1999 in the Central Valley (Gervais 2002).

Owls appear to forage within close proximity to their burrow during the nesting season, usually within a few hundred to a thousand meters (Haug and Oliphant 1990, Sissons et al. 2001, Gervais 2002, Gervais et al. 2003, Rosenberg and Haley 2003). Foraging owls have been detected up to 2.7 km from the nest burrow (Haug and Oliphant 1990). Generalizing from the field studies on habitat selection while foraging is confounded by the use of different analysis methodologies, but owls in Saskatchewan appeared to avoid cropland in a mixed landscape in two instances, and one owl appeared to avoid fallow land in the same study area (Sissons et al. 2001). An earlier study in Saskatchewan also suggested that owls avoided cropland in favor of grass-forb (Haug and Oliphant 1990; but see Gervais et al. 2003 for methodological issues). However, in the Central Valley of California, owls used whatever cover types were available close to the nest burrow and there was no indication of avoidance of crop cover types (Gervais et al. 2003). Over 80% of foraging observations during the breeding season occurred within 600 m of the nest burrow in the Central and Imperial Valleys (Gervais et al. 2003, Rosenberg and Haley 2003).

### **Threats**

The primary threat to burrowing owls appears to be loss of suitable habitat due to urban development and eradication of ground squirrels. Most of the extirpated populations identified by DeSante et al. (1997, unpublished data) are in counties along the coast, which have experienced tremendous growth over the last few decades. Growth is also increasing in the

Central Valley, and loss of agricultural and other open landscapes is likely to impact owl populations. Burrowing owls do persist in urban environments, but in Florida, higher densities of development supported fewer owls and were correlated to lower rates of nest success (Millsap and Bear 2000). Interestingly, lower rates of development appeared to benefit the owls due to increased prey availability around homes, and reduced mortality from natural causes (Millsap and Bear 2000).

In addition to loss of nesting burrows due to lack of tolerance of ground squirrels, developed environments pose a substantial risk to burrowing owls due to mortality caused by traffic (Konrad and Gilmer 1984, Haug and Oliphant 1997, Clayton and Schmutz 1997, Millsap 2002, D. K. Rosenberg et al., unpublished data). Owls nesting along roadsides or parking lots would perhaps be at greatest risk, although owls were observed to forage along roads over 1 km from the nest burrow (J. A. Gervais, personal observation).

Pesticides may impact burrowing owl populations living in heavily agricultural environments (James and Fox 1987, James et al. 1990). In the Central Valley, however, there was no indication that foraging owls selected fields recently treated for pesticides, although owls did use crops extensively during foraging activities (Gervais et al. 2003). Although undoubtedly some owls do die of pesticide exposure, and some owls carry body burdens of persistent contaminants such as DDE that may impair reproduction or survival (Gervais et al. 2000), an analysis of the potential impacts of pesticide exposure rates on population growth rate suggested negligible effects (Gervais 2002, Gervais and Anthony in press).

The largest populations of burrowing owls remaining in California occur in agricultural environments. In addition to possible pesticide exposure, these owls are very vulnerable to land use practices. Discing to control weeds in fallow fields may destroy burrows, and the

management of water conveyance structures will determine whether burrows persist through the breeding season (Rosenberg and Haley 2003). Ironically, the high density of owls present in the Imperial Valley is almost certainly due to agricultural development, and these populations are unlikely to remain at current levels if water conveyance structures are buried or if management increases the disturbance of the substrate (Rosenberg and Haley 2003).

Although natural predation may be significant in grassland habitats such as the Carrizo Plains (Ronan 2002), predators such as large raptors and coyotes may also benefit owls in more disturbed areas by checking the populations of feral predators such as domestic cats although there is no data on this question.

### **Management and Research Recommendations**

Research should focus on determining the population status in large publicly-owned grasslands, as these have not been systematically surveyed with the exception of the Carrizo Plains and may harbor large populations of owls that are safe from imminent development. In addition, dispersal and metapopulation dynamics may be important in maintaining existing populations that are small, and in recolonizing populations. However, we currently have little information regarding juvenile owl dispersal in California, although research was initiated in 2002 (Rosenberg and Catlin, unpublished data). Preliminary data suggests that adult dispersal is much greater than previously thought (D. K. Rosenberg, unpubl. data).

Burrowing owls readily use artificial burrows, and these may be used to enhance habitat quality in areas that lack burrows but otherwise appear suitable. However, these should be inspected annually to maintain useable condition.

The management of water conveyance structures, particularly in the Imperial Valley, will have the potential to greatly impact burrowing owls. Maintenance of delivery canals and ditches

should be done in such a way to minimize disturbance to breeding burrows. Wintering owls are also present in large numbers, making maintenance operations difficult. Research on better coordinating the maintenance of water conveyance structures to minimize damage to owl nests is needed.

### **Monitoring Needs**

Although burrowing owls have clearly declined in some parts of their range in California, specific data is often lacking in other parts of the state. It appears that there has been a shift in population density, such that the Central and Imperial Valleys support populations have reached densities that were probably not present historically. In addition, owls can be quite difficult to detect, particularly in large natural grasslands (D. K. Rosenberg, unpublished data). It is very likely that the populations of burrowing owls persisting in the Carrizo Plains and other large tracts of public land are much larger than originally estimated due to the difficulty of detection. Monitoring using improved survey methods that account for the probability of detection is needed over a wide range of habitat types.

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